MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

TGD2151 – COMPUTER GRAPHICS FUNDAMENTALS

(All sections / Groups)

13 MARCH 2018
2.30 p.m. – 4.30 p.m.
(2 Hours)

Question No.	Marks
1	
2	
3	
4	
Total	

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 9 pages with 4 Questions only.

2. Answer **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers CLEARLY in this Question paper.

QUESTION 1

a) Given two colors, $C_1 = (0.2, 0.1, 0.4)$ and $C_2 = (0.9, 0.7, 0.8)$, find the color $C_3 = (r, g,$
   b) in between the two colors by using linear interpolation method if $r = 0.5$.

[3 marks]

b) The coordinate system of a model will be transformed multiple times as it passes through the OpenGL pipeline. List down in correct order for the **FIVE (5)** coordinate systems involved and briefly describe each of its functionality.

[5 marks]

c) Polygon is an ordered list of vertices. For filling polygons with particular colors, one needs to determine the pixels falling on the border of the polygon and those falling inside the polygon.

Flood Fill and **Boundary Fill** are two popular area filling algorithms. Compare them in terms of number of colors applied and the condition for setting the pixels.

[2 marks]

Flood Fill Algorithm	Boundary Fill Algorithm

QUESTION 2

a) Given a straight line with pixel coordinate (4, 6) and (8, 9), derive the equation below using Digital Differential Analyzer (DDA) line algorithm.
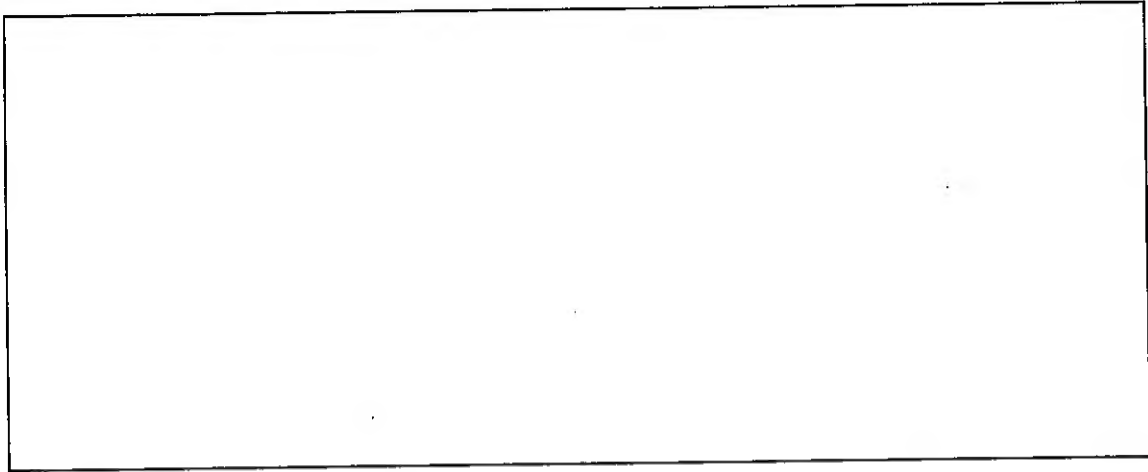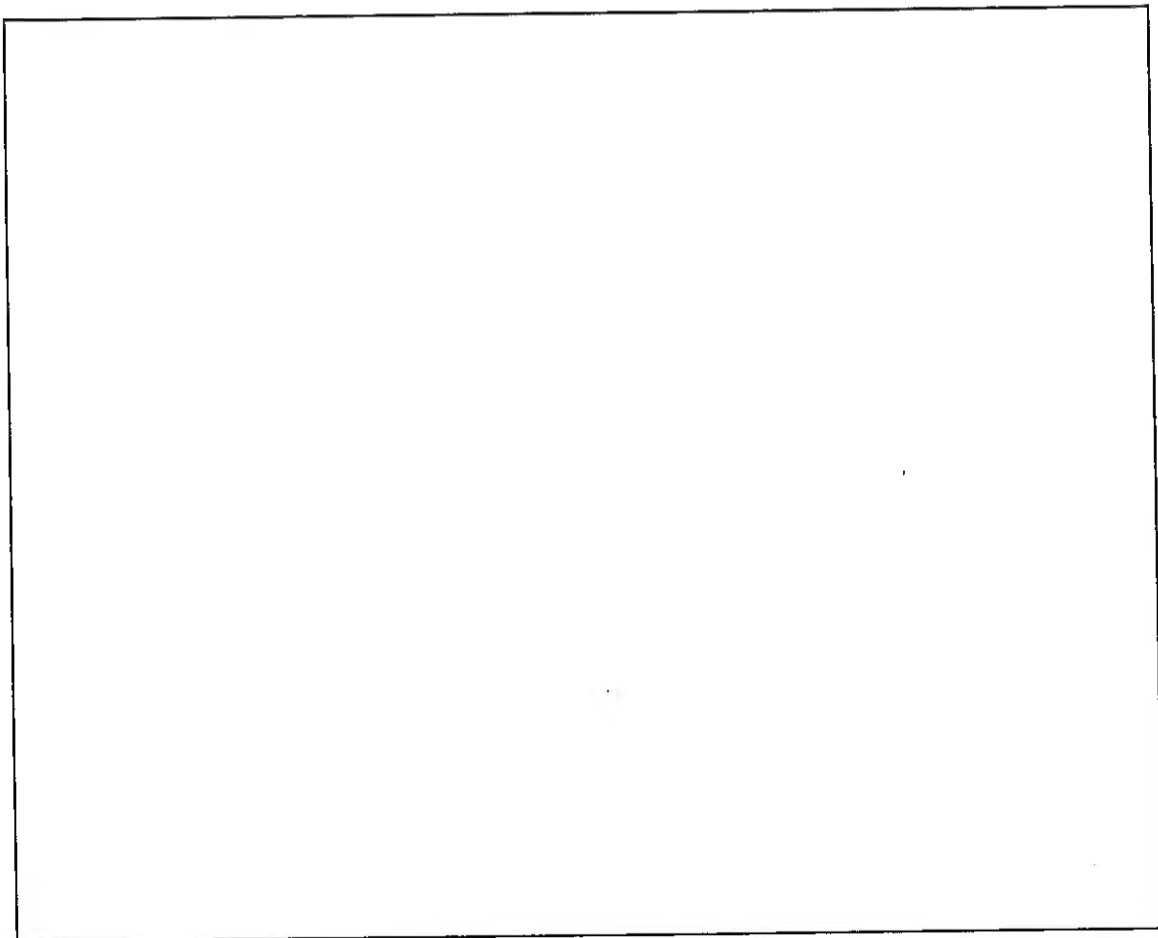
[3 marks]

$$y_{k+1} = y_k + m$$

b) Using DDA line algorithm in Question 2(a), compute the second and third pixel coordinates if the first pixel coordinate is (4, 6)?

[2 marks]

c) Given two affine transformations in 3D, T_1 is a translation, and T_2 is a reflection about the XY plane. Is the multiplicative result of T_1T_2 same as T_2T_1? Prove it mathematically for the general case.
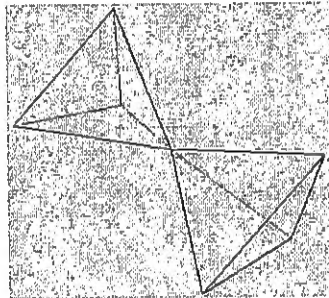
[3 marks]

d) Is shearing an affine transformation? Explain your answer.

[2 marks]

QUESTION 3

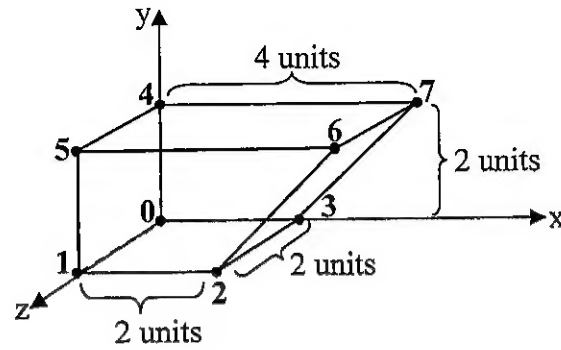a) Define Euler's formula and proof whether the object below is a polyhedral by using the formula.

[1 mark]

b) Complete the blanks in the Face list and Normal list based on the indices and lengths given in the object below.

[4 marks]

Face List			
P_a	P_b	P_c	P_d
	3		1
0		5	
	4		3
2		7	
1		6	
4		6	

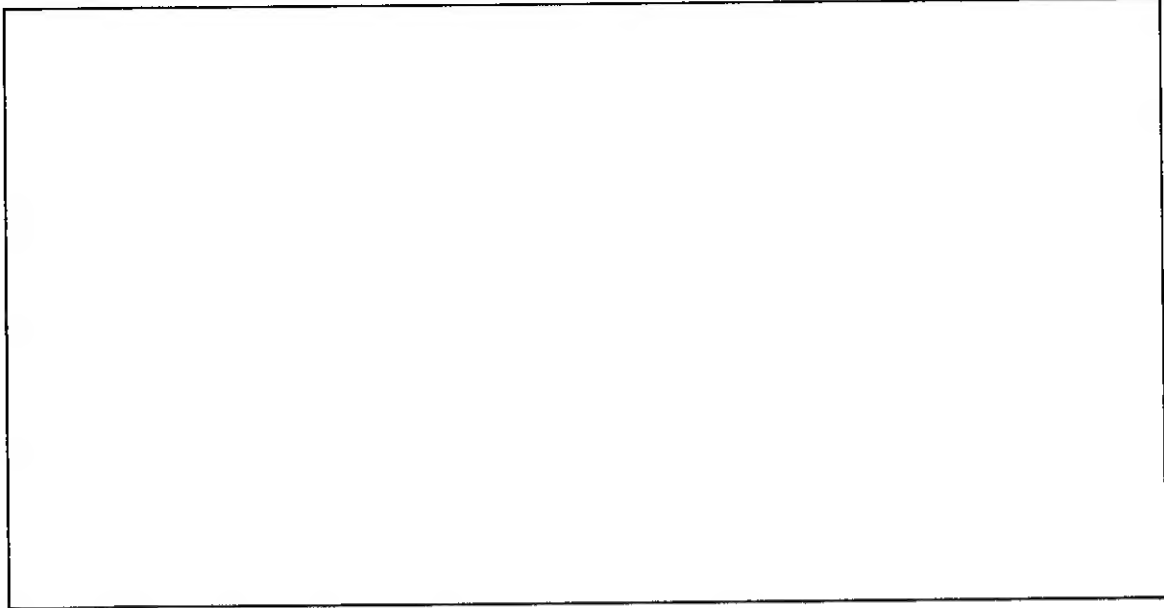| Normal List		
N_x	N_y	N_z
0		
		0
		-1
		0
0		
0		

c) Given a camera located at point (1,1,1), looking at point (0,1,1) and with an up-vector of (0,0,-1), compute the *u-v-n* reference frame coordinate.

[3 marks]

Continued...

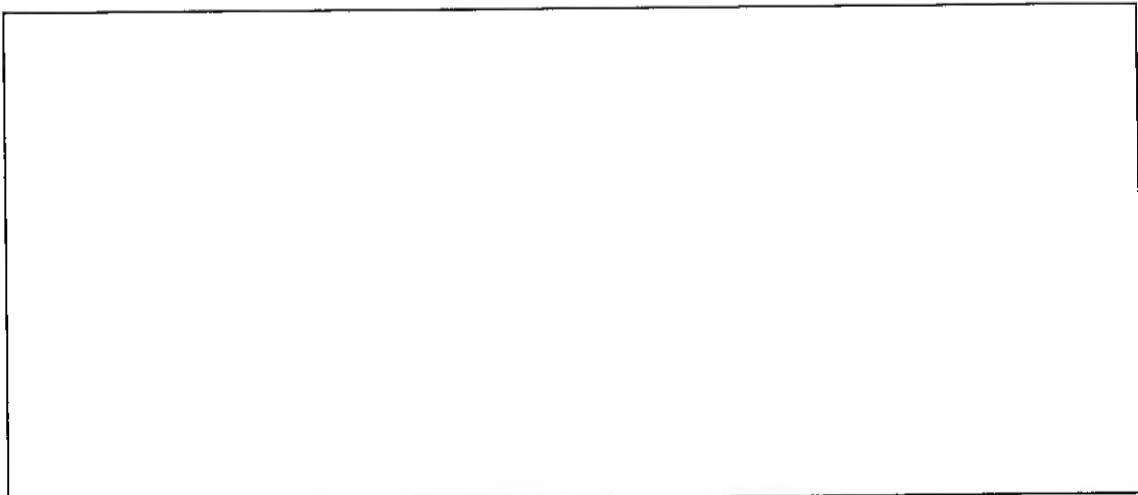d) Explain how Z-Buffer algorithm works.

[2 marks]

QUESTION 4

a) A perspective projection creates a 3D viewing frustum. Draw a sketch of the viewing frustum created by the OpenGL commands below and label it based on the specific parameter values given.

```
float      viewAngle = 60.0;
float      aspectRatio = 2.0;
float      near = 1.0;
float      far = 20.0;
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
gluPerspective(viewAngle, aspectRatio, near, far);
```
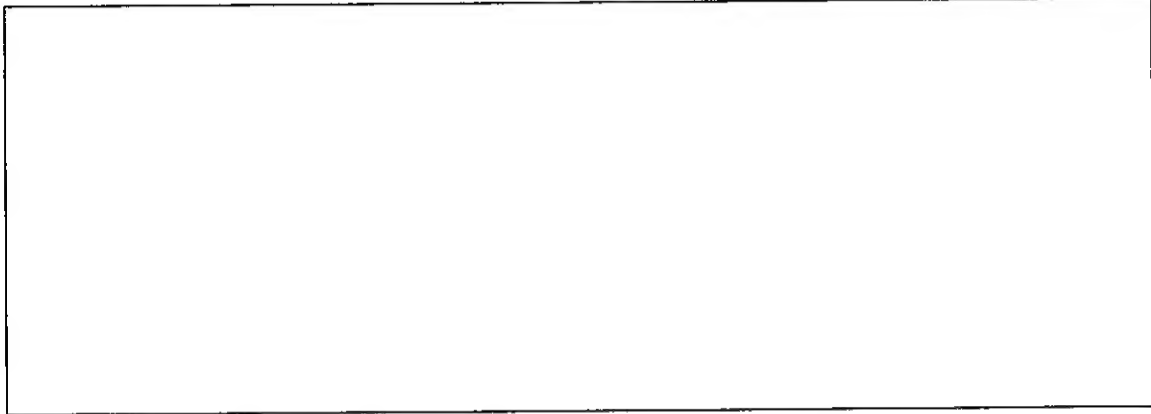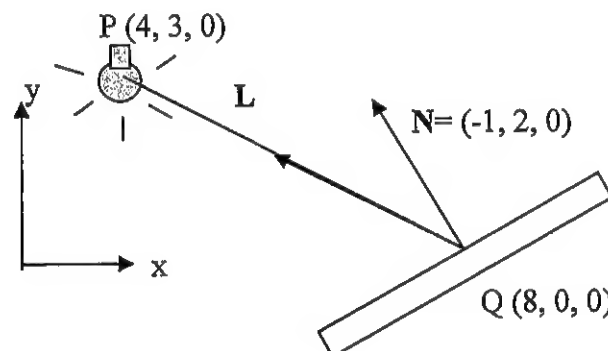
[2 marks]

b) Determine which surfaces below are visible to a viewer at position (0, 5, 5), looking at point P (0, 0, 1) on an object.

i) Face B with normal vector N2 = (1, -4, 3)
ii) Face D with normal vector N4 = (-1, 1, 2)

[2 marks]

c) A light bulb and a mirror are located to the following location and orientation.

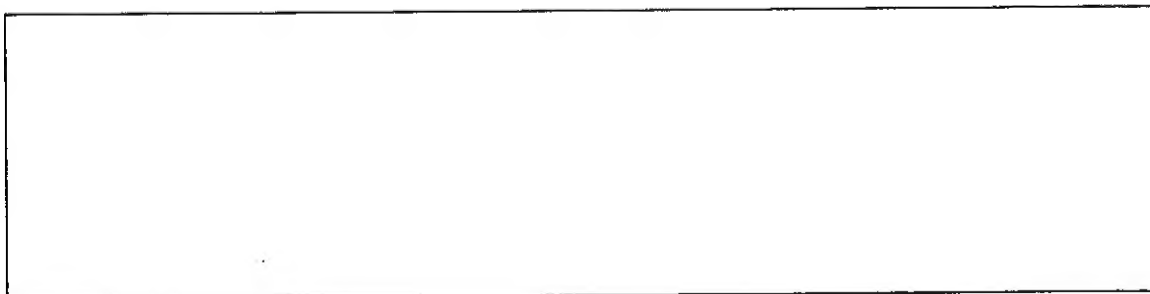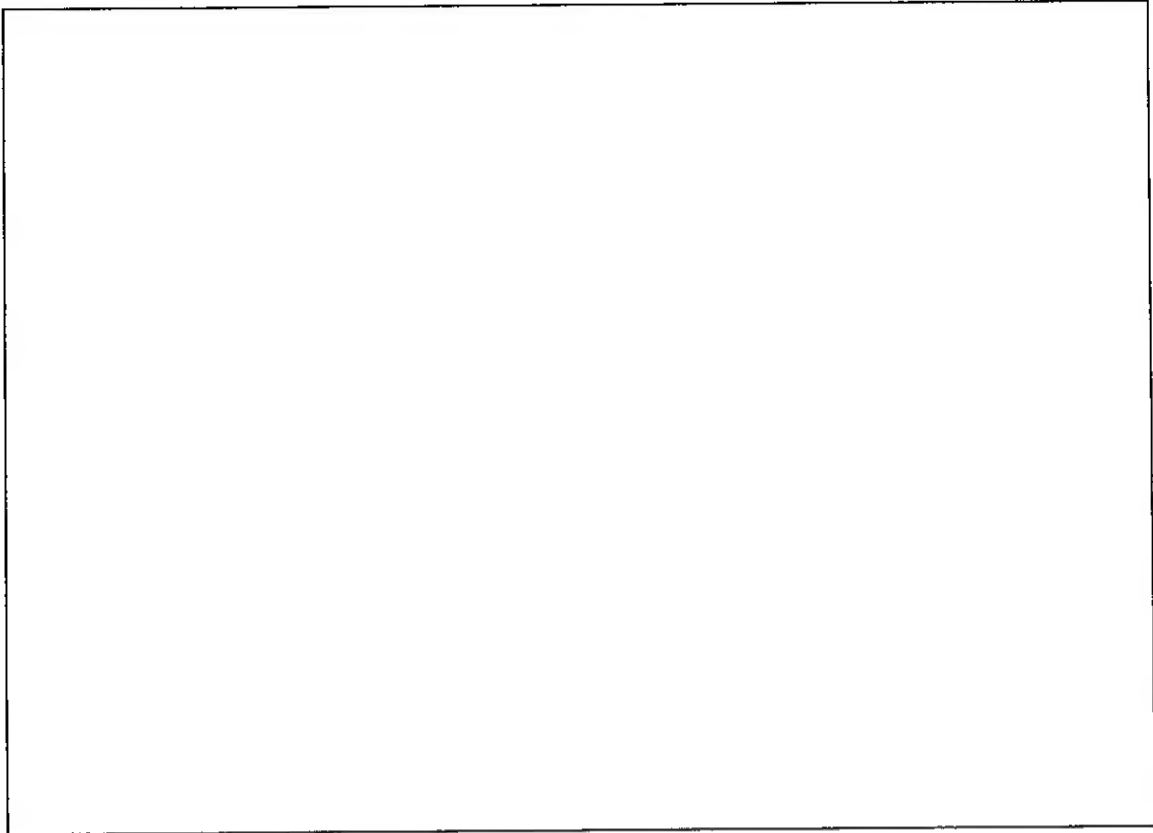P (4, 3, 0)

L

N= (-1, 2, 0)

$k_a = k_d = 0.8$

Q (8, 0, 0)

[5 marks]

Assuming that the light bulb is a point light source at (4, 3, 0) and the lighting is attenuated by a factor of 2/d. The light intensity at point P is $I_p = 1$.

i) What is the intensity of the light source at point Q?
ii) Let the ambient intensity be $I_a = 0.1$, with basic illumination lighting model, find the total diffuse reflection at point Q.
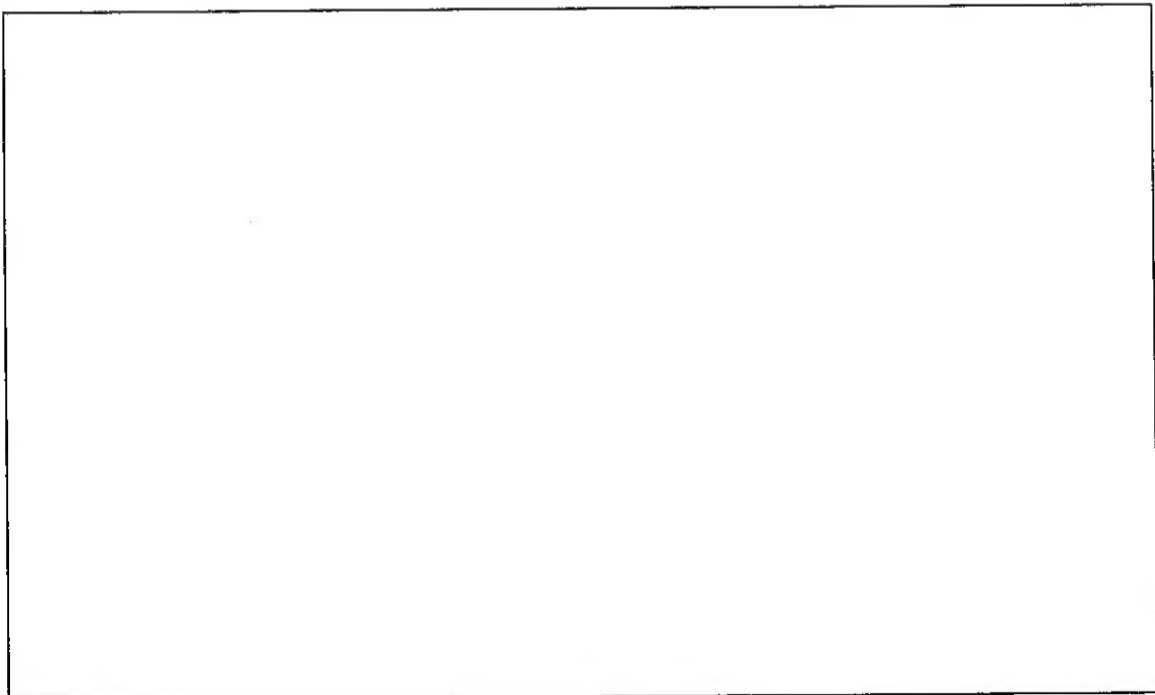
d) Describe the strength and weakness of Gouraud shading method as compared to Phong shading method.

[1 mark]